Solar-B

a closer look at the Sun

The Sun's Magnetism

Magnetic fields are found throughout the Universe: surrounding planets and in the atmospheres of stars; in pulsars, with strengths a billion times greater than the Sun's; and on very large scales, such as cosmic jets emanating from the active cores of distant galaxies.

The Sun has a cycle of activity that rises and falls over the course of about 11 years. In active times, powerful magnetic fields surge from inside the Sun, heat its atmosphere to more than several million degrees, and trigger colossal explosions of plasma and radiation that blast out into space.

Some of those solar blasts hammer the Earth with high-speed charged particles, energizing auroras around the poles. These same solar storms can cause power blackouts, communications interference, and damage to satellites. They are also dangerous to astronauts in space.

Solar-B Mission

The Solar-B mission is an international collaboration between Japan, the United States, and the United Kingdom, and follows the successful Yohkoh (Solar-A) mission. Solar-B is scheduled to launch from Kagoshima, Japan in September 2006. It will ride an M-V rocket into a polar, Sun-synchronous orbit 600 kilometers above the Earth's surface, where it will spend three years almost continuously observing the Sun.

Solar-B's array of advanced optical, ultraviolet, and X-ray instruments will let us study solar structures and processes on very small scales and across a broad range of wavelengths. We will measure magnetic fields and electric currents in enough detail to understand the causes of eruptions in the solar atmosphere, and relate those eruptions to the intense heating of the corona and the mechanisms that drive the solar wind.

International Partners

Spacecraft Mission Management: Japan (JAXA)

Solar Optical Telescope (SOT)

- Optical Telescope Assembly (OTA), instrument integration: Japan (JAXA)
- Focal Plane Package (FPP): Lockheed Martin Solar and Astrophysics Lab

X-ray Telescope (XRT)

- Telescope, filters, mechanisms, and instrument integration:
  - Smithsonian Astrophysical Observatory (SAO)
- Camera and electronics: Japan (JAXA)

Extreme Ultraviolet Imaging Spectrometer (EIS)

- Optics and mechanisms: U. S. Naval Research Laboratory (NRL)
- Structure, camera, electronics, and instrument integration: United Kingdom (PPARC)

Credits

Japan Aerospace Exploration Agency (JAXA)
National Aeronautics and Space Administration (NASA)
Lockheed Martin Solar and Astrophysics Lab

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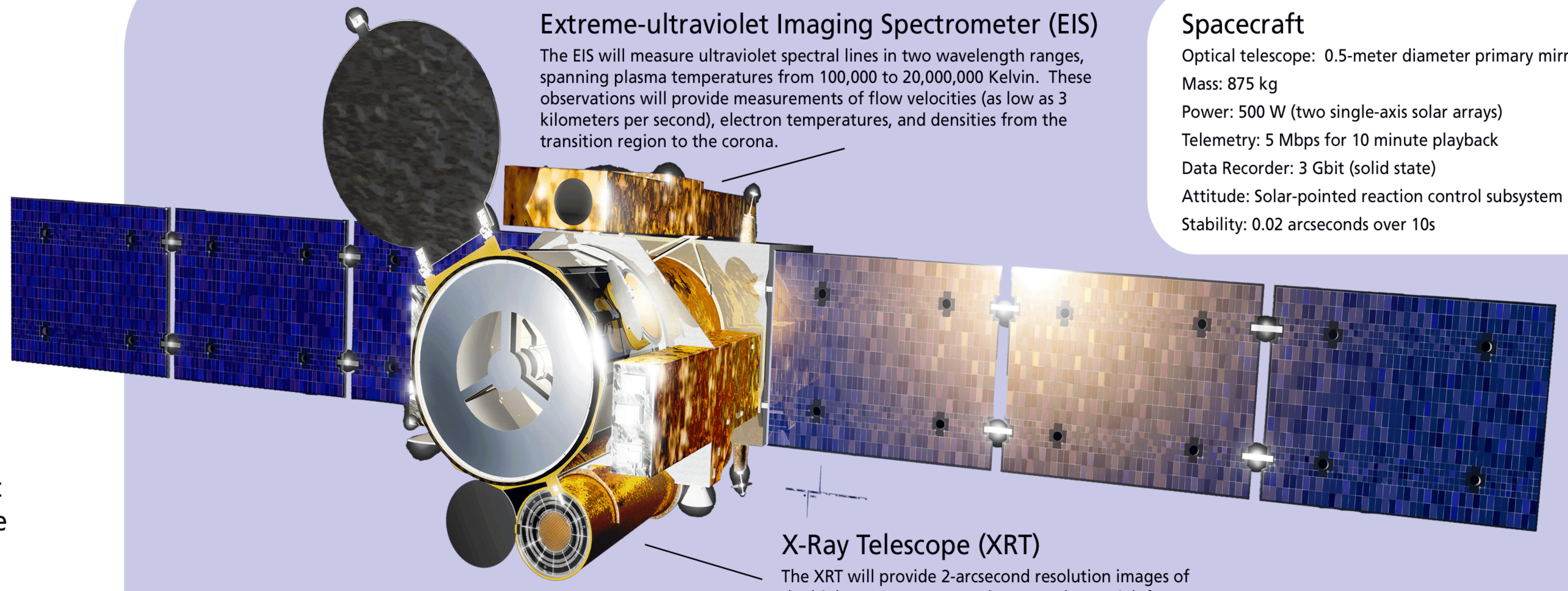


Extreme-ultraviolet Imaging Spectrometer (EIS)

The EIS will measure ultraviolet spectral lines in two wavelength ranges, spanning plasma temperatures from 100,000 to 20,000,000 Kelvin. These observations will provide measurements of flow velocities (as low as 3 kilometers per second), electron temperatures, and densities from the transition region to the corona.

X-Ray Telescope (XRT)

The XRT will provide 2-arcsecond resolution images of the highest temperature solar coronal material, from 1,000,000 to 10,000,000 Kelvin.

Spacecraft

Optical telescope: 0.5-meter diameter primary mirror
Mass: 875 kg
Power: 500 W (two single-axis solar arrays)
Telemetry: 5 Mbps for 10 minute playback
Data Recorder: 3 Gbit (solid state)
Attitude: Solar-pointed reaction control subsystem (RCS)
Stability: 0.02 arcseconds over 10s

Mission Objectives

Understand the creation and destruction of the Sun's magnetic field

The processes that drive the solar magnetic dynamo, the source of the Sun's magnetism, are hidden beneath the Sun's surface. The processes that dissipate the Sun's magnetic field and cause the 11-year solar cycle are not well understood either. By observing magnetic fields emerging from within the Sun in high detail and with great speed, Solar-B will help answer these questions.

Understand solar eruptions and solar wind

Magnetic energy emerging from within the Sun heats the solar atmosphere, which in turn powers eruptions such as flares, spicules, and coronal mass ejections. These eruptions drive the solar wind—a flow of electrically charged particles (plasma) and magnetic fields—outward from the Sun at a million miles per hour or more, past the Earth and the other planets of the Solar System.

On Earth, disturbances in the solar wind can shock our planet's magnetic field and cause "geomagnetic storms." Such disturbances in Earth's magnetic field can energize spectacular auroras, cause communications interference, and induce overloads in electrical power grids and equipment.

Solar-B will observe the source of the solar wind and the disturbances it creates. These detailed observations will help us better understand this crucial Sun-Earth connection.

Understand variability of the Sun's luminosity

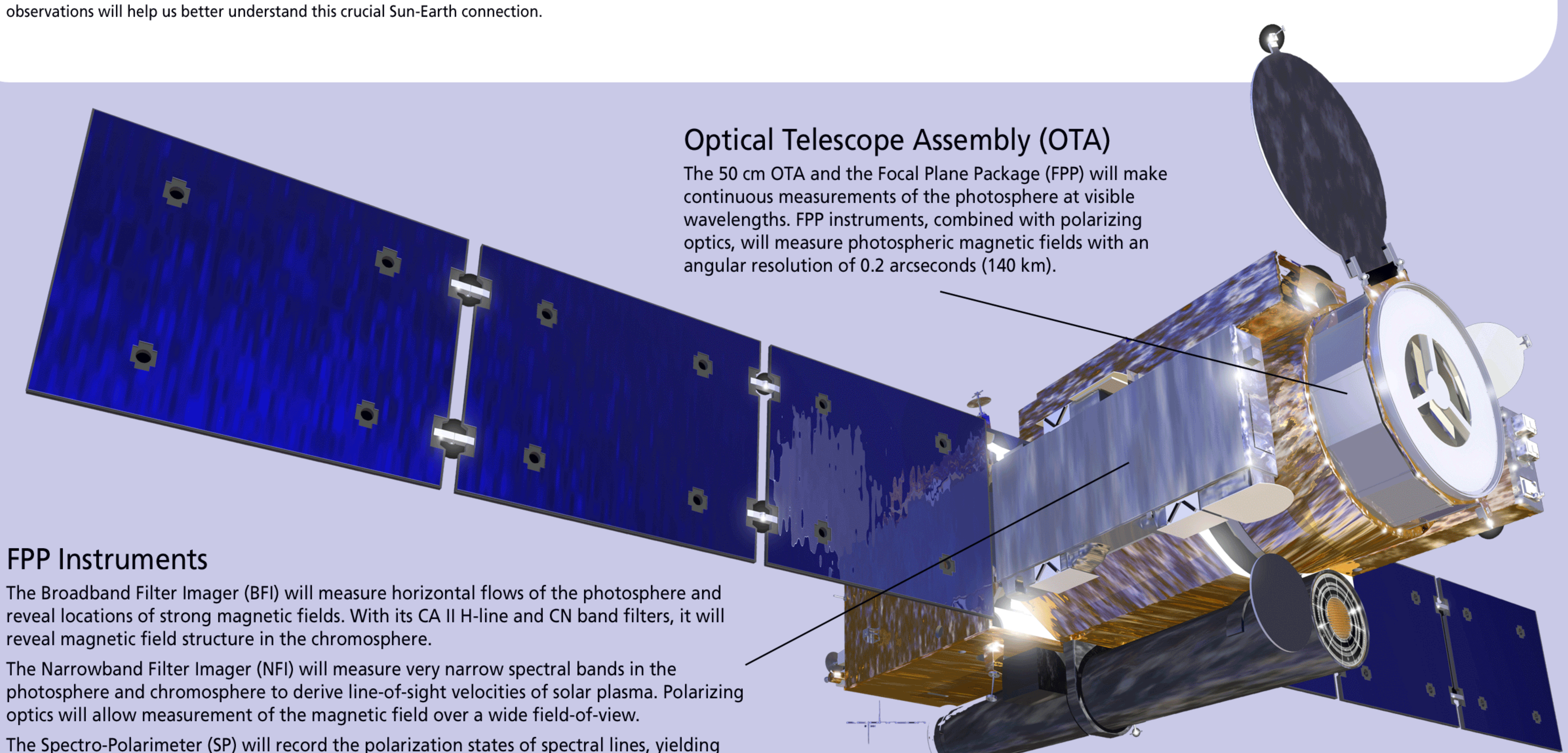
Small variations in the Sun's energy output can change weather and climate on Earth. During the 17th century, an abnormal period of low solar activity coincided with the "Little Ice Age" in northern Europe. Observations from space have shown that the total energy output of the Sun changes with variations in its magnetic cycle.

Solar-B will continuously monitor the buildup of sunspots as well as extremely small-scale magnetic structures as the Sun heads toward the next peak in its activity cycle.

Understand the generation of ultraviolet and x-ray radiation

Radiation pours from the Sun. Its super-heated chromosphere and corona are powerful, highly variable sources of ultraviolet and X-ray radiation. Solar flare explosions produce intense bursts of gamma radiation and blasts of energetic particles. All of this high-energy activity affects Earth's ionosphere, ozone layer, and environment.

Solar-B will study magnetic reconnection and wave dissipation in the chromosphere and corona—processes that are believed to convert solar magnetic energy into ultraviolet and X-ray radiation.



Optical Telescope Assembly (OTA)

The 50 cm OTA and the Focal Plane Package (FPP) will make continuous measurements of the photosphere at visible wavelengths. FPP instruments, combined with polarizing optics, will measure photospheric magnetic fields with an angular resolution of 0.2 arcseconds (140 km).

FPP Instruments

The Broadband Filter Imager (BFI) will measure horizontal flows of the photosphere and reveal locations of strong magnetic fields. With its CA II H-line and CN band filters, it will reveal magnetic field structure in the chromosphere.

The Narrowband Filter Imager (NFI) will measure very narrow spectral bands in the photosphere and chromosphere to derive line-of-sight velocities of solar plasma. Polarizing optics will allow measurement of the magnetic field over a wide field-of-view.

The Spectro-Polarimeter (SP) will record the polarization states of spectral lines, yielding measurements of the three-dimensional magnetic field vector in the photosphere.